Method of Test for

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE

DOTD Designation: TR 113M/113-99

INTRODUCTION

These methods of test are designed to determine the particle size distribution of fine and coarse aggregates. The mix of coarse and fine particles within the material being tested, in conjunction with the proposed use of the material, determines which test method is to be used. Table 1, Testing Requirements, identifies the basic appropriate test method. When materials are not listed in Table 1, the department will determine the test method to be used. When the percentage of material passing the 75µm (No. 200) sieve is critical to the proposed use, the district laboratory engineer has the authority to require a washed gradation in addition to or in place of dry sieving.

These methods are not to be used alone for sieve analysis of aggregates recovered from asphaltic mixtures or for the sieve analysis of mineral fillers. The sieve analysis of mineral filler is to be determined in accordance with DOTD TR 102. The sieve analysis of aggregates recovered from asphaltic mixtures is determined in accordance with DOTD TR 309; only the steps for dry sieving in this procedure are used in conjunction with TR 309.

TABLE OF METHODS

Method A - Dry sieve only.
Method B - Wash and dry sieve.
Method C - Split sample. Dry sieve, then wash representative portion of material passing the 4.75 mm sieve.

TABLE 1
Testing Requirements

Specification Subsection	Material	Method
1003.02(a)	Concrete Sand or Mortar Sand	TR 112 & TR 113 Method B
1003.02(b)(1)	Uncrushed Coarse Aggregate for Concrete	TR 112 & TR 113 Method B
1003.02(b)(2)	Crushed Coarse Aggregate for Concrete	TR 112 & TR 113 Method B
1003.02(b)(3)	Lightweight Aggregate for Concrete	TR 113 Method A
1003.02(b)(4)	Recycled PCC	TR 112 & TR 113 Method B
1003.03(a)	Sand Clay Gravel	TR 112 & TR 113 Method C
1003.03(c)(2)	Sand	TR 112 & TR 113 Method B
1003.03(d)	Stone	TR 112 & TR 113 Method C
1003.03(e)	Recycled PCC	TR 112 & TR 113 Method C
1003.03(f)	Crushed Slag	TR 112 & TR 113 Method A
1003.04(a)	Stone	TR 112 & TR 113 Method C
1003.04(b)	Sand Clay Gravel	TR 112 & TR 113 Method C
1003.04(c)	Shell	*TR 112 & TR 113 Method B

---- *continued* ----

TABLE 1 - Testing Requirements *(continued)*

Specification Subsection	Material	Method
1003.04(d)	Recycled PCC	TR 112 & TR 113 Method C
1003.04(e)	RAP	TR 113 Method A
1003.04(f)	Crushed Slag	TR 113 Method A
1003.05	Aggrs. for Asphaltic Surface Treatment, Excluding Lightweight	TR 112 & TR 113 Method B
1003.05	Lightweight Aggrs. for Asphaltic Surface Treatment	TR 113 Method A
1003.06(a)(1)	Gravel, Stone & Slag	TR 112 & TR 113 Method B
1003.06(a)(2)	Coarse Sand	TR 112 & TR 113 Method B
1003.06(a)(3)	Fine Sand	TR 112 & TR 113 Method B
1003.06(a)(4)	Natural Sand	TR 112 & TR 113 Method B
1003.06(a)(5)	Crushed Shell	* TR 112 & TR 113 Method B
1003.06(a)(6)	Screenings	TR 112 & TR 113 Method B
1003.06(a)(7)	Expanded Clay	TR 113 Method A
1003.06(a)(8)	Pit Run Sand-Gravel	TR 112 & TR 113 Method B
1003.06(a)(9)	Recycled PCC	TR 112 & TR 113 Method B
1003.06(a)(10)	RAP	TR 113 Method A
1003.06(b)	Crushed Gravel Stone or Crushed Slag for Asphalt Treated Drainage Blanket	TR 112 & TR 113 Method B
1003.07	Granular Material	TR 112 & TR 113 Method B
1003.08	Bedding Material, excluding Shell	TR 113 Method A
1003.08(c)	Bedding Material, Shell	* TR 112 & TR 113 Method B
1003.09	Sand and Shell for Embankment	TR 112 & TR 113 Method B
Spec. Prov. P250, P395 & P505, Sec. 203, 301 & 302	Blended Calcium Sulfate	TR 113 Method A
Spec. Prov. P395 & P505 Sections 301 & 302	Crushed Gravel	TR 112 & TR 113 Method C
Spec. Prov. P563 Sec. 305	Blended Calcium Sulfate	TR 113 Method A
Spec. Prov. P563 Sec. 305	Crushed Gravel	TR 112 & TR 113 Method C
Spec. Prov. P493 Sec. 307	Crushed Stone	TR 112 & TR 113 Method B
Spec. Prov. P374 S-Item	Block Fill-Stone or Crushed Gravel	TR 113 Method A
Spec/. Prov. P374 S-Item	Backfill	TR 112 & TR 113 Method B

** For shell, wash in accordance with TR 109, in lieu of TR 112*

REFERENCE DOUCMENTS

1. AASHTO Designation: M 92, Standard Specifications for Sieves for Testing Purposes
2. DOTD TR 112, Amount of Material Finer than the 75 µm Sieve
3. DOTD TR 108, Splitting and Quartering Samples
4. DOTD TR 106, Determining Total Moisture and Free Moisture in Aggregates

OVERLOADING

A sieve is considered overloaded when the mass of the material retained on a sieve exceeds the maximum allowed as follows:

1. For sieves with openings 4.75 µm (No. 4) and larger, the mass in kilograms shall not exceed the product of 2.5 x sieve opening in millimeters x effective area of sieving surface in square meters (the mass in pounds shall not exceed the product of 0.089 x sieve opening in inches x effective area of sieving surface in square inches).

2. For sieves with openings smaller than 4.75 µm (No. 4), the mass in kilograms shall not exceed 7 x effective area of sieving surface in square meters (the mass in pounds shall not exceed 0.01 x area of sieving surface in square inches) .

Table 2 shows the maximum allowable mass retained on any sieve at the completion of the sieving operation for standard screen sizes based on the above relationships.

Table 2
Maximum Mass of Material Retained on Selected Sieves/Screens

Sieve/ Screen Sizes	BOX SCREEN 420 x 340 mm (16 1/2 x 13 1/2 in) kg (lb)	STD. MECHANICAL SHAKER SCREEN 375 x 580 mm (14 3/4 x 22 3/4 in) kg (lb)	U. S. STANDARD 305 mm (12 in Dia.) kg (lb)	U. S. STANDARD 254 mm (10 in Dia.) kg (lb)	U. S. STANDARD 203 mm (8 in Dia.) kg (lb)
50 mm (2 in)	17.96 (39.65)	27.10 (59.73)	8.38 (18.47)	5.72 (12.61)	3.56 (7.85)
37.5 mm (1 1/2 in)	13.47 (29.74)	20.33 (44.80)	6.28 (13.84)	4.29 (9.46)	2.67 (5.89)
25.0 mm (1 in)	8.98 (19.82)	13.55 (29.86)	4.19 (9.24)	2.86 (6.17)	1.78 (3.92)
19.0 mm (3/4 in)	6.83 (14.87)	10.30 m(22.40)	3.18 (7.01)	2.17 (4.78)	1.35 (2.98)
12.5 mm (1/2 in)	4.49 (9.91)	6.78 (14.93)	2.09 (4.61)	1.43 (3.15)	0.89 (1.96)
9.5 mm (3/8 in)	3.41 (7.43)	5.15 (11.20)	1.59 (3.51)	1.09 (2.40)	0.67 (1.48)
4.75 mm (No. 4)	1.62 (3.71)	2.44 (5.60)	0.0.75 (1.76)	0.54 (1.19)	0.33 (0.73)
< 4.75 mm (No. 4)	1.01 (2.23)	1.52 (3.36)	0.47 (1.43)	0.40 (0.89)	0.20 (0.44)

DEFINITIONS

For the purposes of this test procedures, the following definitions will apply.

Coarse Aggregate - Naturally occurring or manufactured materials that are retained on the 4.75 mm (No. 4) sieve

Fine Aggregate - Naturally occurring or manufactured materials that pass the 4.75 mm (No. 4) sieve.

Decantation Loss - "Decant Loss" on Worksheet. The amount of material loss when washing over the 75μm sieve.

Percent Difference - The difference between the initial dry total mass and the accumulated total mass, expressed as a percentage of initial dry total mass. This difference is usually caused by material loss during testing or weighing errors. This parameter is used to judge the accuracy of the test result.

Split Sample - A representative portion of material passing the 4.75 mm (No. 4) sieve used to reduce sample size in order to determine the gradation of fine aggregate.

Method of Test for
SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE
DOTD Designation: TR 113M/113-99

Method A

I. Scope

This method of test is used to determine the particle size distribution of aggregates by dry sieving only.

II. Apparatus

A. **Balance**
   1. Sample size 2 kg or less, readability and sensitivity to 0.1 g
   2. Sample size greater than 2 kg, but not more than 5 kg, readability and sensitivity to 1 g
   3. Sample size greater than 5 kg, readability and sensitivity to 5 kg

B. **Mechanical Sieve Shaker** - capable of imparting a vertical or lateral and vertical motion to the sieves, causing the particles thereon to bounce and turn, presenting different orientations to the sieving surface

C. **Sieves** - conforming to the requirements for AASHTO Designation: M92. Sieve sizes will be appropriate for the specifications for which the material is being tested. Additional sieves may be necessary to prevent overloading of these primary sieves.

D. **Catch Pan**

E. **Drying Device**
   1. Oven - an oven capable for maintaining a temperature of 110 ±5°C (230 ±9°F).
   2. Hot Plate - an approved hot plate with a shield. Open-flame hot plates must be equipped with a shield which evenly disperses heat and prevents direct contact of the flame with the drying pan.
   3. Miscellaneous tools - spoons, spatulas, brushes, etc.

F. **Personal Protective Equipment** - goggles, dust respirator, equipment for handling hot substances

G. Aggregate Test Report - DOTD Form No. 03-22-0745 (Figure A-1).

III. Health Precautions

Proper equipment and precautions are to be used whenever hot materials or equipment must be handled. Use container holders or gloves while handling hot containers. Use appropriate respirator and turn on ventilation system when working in dusty areas.

IV. Sample

Sample adequate material to comply with Table 1 after drying to constant mass; however, in no case, shall the minimum sample size be less than 13 kg.

V. Procedure

A. Dry the sample in accordance with TR 106.

Note A-1: *Dry reclaimed asphaltic concrete pavement (RAP) at a temperature less than 38°C.*

B. Obtain a representative portion, in accordance with DOTD TR 108, which will yield at least the minimum quantity shown in Table 1. Record on the worksheet as initial dry total mass in the lower entry field.

Note A-2: *To obtain the minimum mass of the representative portion of lightweight aggregate, multiply the values shown in Table 1 by 0.5.*

TABLE 1
Approximate Minimum Mass of Dry Representative Portion

Representative Portion	
[1]Maximum Size	**Approximate Minimum Mass, Dried**
90 mm (3 ½ in)	35 kg
75 mm (3 in)	30 kg
63 mm (2 ½ in)	25 kg
50 mm (2 in)	20 kg
37.5 mm (1 ½ in)	13 kg
25.0 mm (1 in)	10 kg
19.0 mm (3/4 in)	5 kg
12.5 mm (½ in)	2 kg
9.5 mm (3/8 in)	1 kg
4.75 mm (No. 4)	500 g
2.36 mm (No. 8)	100 g

[1]**Maximum Size** - for the purpose of this test procedure, maximum size is defined as the first sieve on which the specifications allow material to be retained.

C. Use the specifications to select the appropriate sieves to determine the particle distribution, including additional sieves necessary to prevent overloading of specification sieves.

Note A-3: *Refer to the Introduction for information on overloading of sieves.*

D. Nest sieves in mechanical shaker in order of decreasing size of openings from top to bottom, placing the catch pan on the bottom.
E. Pour representative portion over top sieve.
F. Turn on mechanical shaker. Continue sieving operation to refusal.

Note A-4: *Refusal is defined as the point when not more than 0.5 % by mass of the representative portion passes through any sieve during one minute of continuous sieving.*

G. Determine the mass of the material retained on each sieve and the catch pan and record on the worksheet in the designated locations as Mass Retained.
H. Check the mass retained for each sieve and refer to the table in the Introduction to determine if any sieve has been overloaded.
   1. In no sieve has been overloaded, proceed to Step I.
   2. If a sieve has been overloaded, recombine the representative portion.
      a. If intermediate sieve(s) are available, insert the appropriate intermediate sieve(s) immediately above the overloaded sieve(s) in the nest, and repeat the sieving operation in accordance with Steps E - H.
      b. If the correct size intermediate sieve(s) are not available, split the recombined representative portion in accordance with TR 108. Repeat Steps E - H for each portion. In Step G, add the masses retained on each sieve size for each portion and record the sum as Mass Retained.
I. Add together the Mass Retained for each individual sieve and the catch pan, then record this sum as Accumulated Total.
J. Determine and record the following to the degree of accuracy shown in the example on the worksheet (Figure A-1).
   1. The percent difference in accordance with Step VI. A. If the percent difference exceeds 0.2 %, obtain a new representative portion and repeat Steps V. A - I or a new sample and repeat the test.
   2. The percent retained on each sieve in accordance with Step VI. B.
   3. The percent coarser than each sieve size in accordance with Step VI. C.
   4. The percent passing each sieve in accordance with Step VI.D.

VI. Calculations

A. Calculate the percent difference using the following formula:

$$D = \frac{W_i - W_a}{W_i} \times 100$$

where:

D = percent difference
W_i = initial dry total mass, g
W_a = accumulated total mass, g
100 = constant, converting decimal to %

example:

W_i = 17 573
W_a = 17 568

$$D = \frac{17\,573 - 17\,568}{17\,573} \times 100$$

$$= \frac{5}{17\,573} \times 100$$

$$= 0.000284 \times 100$$

$$= 0.028$$

$$D = 0.03\ \%$$

B. Calculate the percent retained for each sieve using the following formula:

$$R = \frac{W_x}{W_a} \times 100$$

where:

R = percent retained
W_x = mass retained on each individual sieve (x), g
W_a = accumulated total, g
100 = constant, converting decimal to %

example: *19mm (3/4 in) sieve*

W_{19} = 2 556
W_a = 17 568

$$R = \frac{2\ 556}{17\ 568} \times 100$$

$$= 0.145491 \times 100$$

$$= 14.5491$$

$$R = 14.55$$

C. Calculate the Percent Coarser (Cumulative Percent Retained) for each sieve using the following formula:

$$C_x = \sum R_x$$

where x goes from all sieves >x to x

where:

C_x = percent coarser for each sieve (x)
R_x = percent retained for sieve (x)
$\sum^x$ = sum of % retained on all sieves larger than sieve (x)

example:

$R_{37.5}$ = 0 mm
$R_{19.0}$ = 14.55 mm
$R_{4.75}$ = 82.40 mm

$$C_{4.75mm} = 0 + 14.55 + 82.40$$

$$C_{4.75mm} = 96.95$$

D. Calculate the Percent Passing for each sieve using the following formula:

$$P_x = 100 - C_x$$

where:

P = percent passing
C_x = percent coarser for sieve x
100 = constant representing 100%

example: *4.75 mm sieve:*

$$C_{4.75} = 96.95$$

$$P_{4.75\ mm} = 100 - 96.95$$

$$= 3.05$$

$$P_{4.75\ mm} = 3\ \%$$

VII. Report

Report the percent passing each sieve to the nearest whole percent.

VIII. Normal Testing and Reporting Time

Normal testing and reporting time is 2 days.

MATT MENU SELECTION - 2

Louisiana Department of Transportation and Development

AGGREGATE TEST REPORT

DOTD 03-22-0745
Metric / English
Rev. 11/98

Metric / English: M (M or E - Located on MATT Menu)

Project No.: 999-99-9999 | Material Code: 5565 | Lab No.: 22-999999

Date Sampled: 04-22-99 | Submitted By: 0971 | Quantity: 1000

Purp Code: 3 | Source Code: AA99 | Spec Code: 1 | P.O. No.:

Date Tested: 04-23-99 | Ident: RACC-1 | Plant Code: | Frict.Rating: (1 - 4)

Item No.: 7266(01) | Date Rec'd (lab): 4-22-99 | Sampled By: P.J.

Remarks 1:

Tested By: G.C. | Date: 4/23/99 | Checked By: B.W. | Date: 4/23/99

DOTD TR 102, 112, 113 & 309

Unit: 1 (1 = grams 2 = pounds)

Sieve mm	Sieve In.	Mass (Wt) Retained	% Retained	% Coarser	% Passing
63	2 1/2				
50	2				
37.5	1 1/2	0	0	0	100
31.5	1 1/4				
25.0	1				
19.0	3/4	2556	14.55	14.55	85
16.0	5/8				
12.5	1/2				
9.5	3/8				
4.75	No. 4	14476	82.40	96.95	3
Mass (Wt) Matl.in Pan		536	3.05		
Accum. Total		17568			
Initial Dry Total Mass, (Wt)		17573	% Diff:	0.03	

Unit: 1 (1 = grams 2 = pounds)

Sieve mm/µm	Sieve No.	Mass (Wt) Retained	% Retained	% Coarser	% Passing
2.36	8				
2.00	10				
1.18	16				
600	30				
425	40				
300	50				
180	80				
150	100				
75	200				
53	270				
Mass (Wt) Matl.in Pan					
Decant Loss					
Accum. Total					
Initial Dry Total Mass, (Wt)			% Diff:		
Dry Mass (Wt) After Wash					

Remarks 2:

DOTD TR 428

Liquid Limit: | Plastic Limit:

No. of Blows | Mass Cup + Wet Soil,g | Mass Cup + Dry Soil,g | Mass Water | Cup No. | Mass Cup, g | Mass Dry Soil | % Moisture

Factor | Cup No. | Mass Cup, g | Mass Dry Soil | % Moisture

Plasticity Index:

Absorption, % (T84 or T85)	
Spec Grav SSD (T84 or T85)	
Spec Grav APP (TR 300)	
Effective Spec Grav (TR 300)	
Opt Moist Content, % (TR 418)	
Maximum Density (TR 418) kg/m³ (lb/ft³)	
Lab Comp Method (TR 418)	
Cement, % (TR 432 or SPECIFIED)	
Lime, % (TR 416 or SPECIFIED)	
Other (Additive) Code %	
Clay Lumps, % (TR 119)	
Friable Particles, % (TR 119)	
Clay Lumps & Friable Particles % (TR 119)	
Flat or Elongated Part, % (TR 119)	
Coal & Lignite, % (TR 119)	
Glassy Particles, % (TR 119)	
Iron Ore, % (TR 119)	
Wood, % (TR 119)	
Total (Clay Lumps, Fri.Part., Iron Ore, Coal & Lignite, Wood), % (TR 119)	
Foreign Matter, % (TR 109)	
Clam Shell, % (TR 110)	
Soundness, % Loss (T 104)	
Abrasion, % Loss (T 96)	
Colorimetric Test (1 = Pass, 2 = Fail) (T 21)	
Asphalt Content, % (TR 307)	
Retained Asphalt Coating, % (TR 317)	
Percent Crushed (TR 306)	
Retained Marshall Stability (TR 313)	
Resistivity, ohm - cm (TR 429)	
pH (TR 430)	
Organic Content, % (TR 413)	
Sand Equivalent (TR 120)	

Approved By: | Date:

Figure A-1 Aggregate Test Report (03-22-0745)

DOTD Designation: TR 113M/113-99

Method B

I. Scope

This method of test is used in conjunction with DOTD TR 112 to determine the particle size distribution of aggregates by washing and dry sieving.

II. Apparatus

A. **Balance**
   1. Sample size 2 kg or less, readability and sensitivity to 0.1 g
   2. Sample size greater than 2 kg, but not more than 5 kg, readability and sensitivity to 1 g
   3. Sample size greater than 5 kg, readability and sensitivity to 5 kg

B. **Mechanical Sieve Shaker** - capable of imparting a vertical or lateral and vertical motion to the sieves, causing the particles thereon to bounce and turn, presenting different orientations to the sieving surface

C. **Sieves** - conforming to the requirements of AASHTO Designation: M92. Sieve sizes will be appropriate for the specifications for which the material is being tested. Additional sieves may be necessary to prevent overloading of these primary sieves.

D. **Catch Pan**

E. **Drying Device**
   1. Oven - an oven capable for maintaining a temperature of 110 ±5°C (230 ±9°F).
   2. Hot Plate - an approved hot plate with a shield. Open-flame hot plates must be equipped with a shield which evenly disperses heat and prevents direct contact of the flame with the drying pan.

F. **Miscellaneous tools** - spoons, spatulas, brushes, etc.

G. **Personal Protective Equipment** - goggles, dust respirator, equipment for handling hot substances

H. **Aggregate Test Report** - DOTD Form No. 03-22-0745 (Figure B-1)

III. Health Precautions

Proper equipment and precautions are to be used whenever hot materials or equipment must be handled. Use container holders or gloves while handling hot containers. Use appropriate respirator and turn on ventilation system when working in dusty areas.

IV. Sample

Obtain a sample adequate to comply with Table 1 after drying to constant mass; however, in no case, shall the minimum sample size be less than 13 kg.

V. Procedure

A. Dry the sample in accordance with TR 106.

B. Obtain a representative portion, in accordance with DOTD TR 108, which will yield at least the minimum quantity shown in Table 1. Record on the worksheet as initial dry total mass in the lower entry field.

TABLE 1
Approximate Minimum Mass of Dry Representative Portion

Representative Portion	
[1]Maximum Size	Approximate Minimum Mass, Dried
90 mm (3 ½ in)	35 kg
75 mm (3 in.)	30 kg
63 mm (2 ½ in)	25 kg
50 mm (2 in)	20 kg
37.5 mm (1 ½ in)	13 kg
25.0 mm (1 in)	10 kg
19.0 mm (3/4 in)	5 kg
12.5 mm (½ in)	2 kg
9.5 mm (3/8 in)	1 kg
4.75 mm (No. 4)	500 g
2.36 mm (No. 8)	100 g

[1]**Maximum Size** - for the purpose of this test procedure, maximum size is defined as the first sieve on which the specifications allow material to be retained.

C. Determine the decantation loss, in accordance with DOTD TR 112.

D. Use the specifications to select the appropriate sieves to determine the particle distribution, including additional sieves necessary to prevent overloading of specification sieves.

Note B-1: *Refer to the Introduction for information on overloading of sieves.*

E. Nest sieves in mechanical shaker in order of decreasing size of openings from top to bottom, placing the catch pan on the bottom.
F. Pour the dried test specimen remaining from TR 112 over top sieve.
G. Turn on mechanical shaker. Continue sieving operation to refusal.

Note B-2: *Refusal is defined as the point when not more than 0.5 % by mass of the test specimen passes through any sieve during one minute of continuous sieving.*

H. Determine the mass of the material retained on each sieve and the catch pan and record on the worksheet in the designated locations as Mass Retained.
I. Check the mass retained for each sieve and refer to the table in the Introduction to determine if any sieve has been overloaded.
I. In no sieve has been overloaded, proceed to Step J.
   1. If a sieve has been overloaded, recombine the test specimen.
      a. If intermediate sieve(s) are available, insert the appropriate intermediate sieve(s) immediately above the overloaded sieve(s) in the nest, and repeat the sieving operation in accordance with Steps F - I.
      b. If the correct size intermediate sieve(s) are not available, split the recombined test specimen in accordance with DOTD TR 108. Repeat Steps F - I for each portion. In Step H, add the masses retained on each sieve size for each portion and record the sum as Mass Retained.
J. Add together the Mass Retained for each individual sieve, the catch pan, and the "decant loss" from TR 112, then record this sum as Accumulated Total.
K. Determine and record the following:
   1. The percent difference in accordance with Step VI. A. If the percent difference exceeds 0.2 %, obtain a new sample and repeat the entire test procedure.
   2. The percent retained on each sieve in accordance with Step VI. B.
   3. The percent coarser than each sieve size in accordance with Step VI. C.
   4. The percent passing each sieve in accordance with Step VI. D.

VI. Calculations

A. Calculate the percent difference using the following formula.

$$D = \frac{W_i - W_a}{W_i} \times 100$$

where:

D = percent difference
W_i = initial dry total mass, g
W_a = accumulated total mass, g
100 = constant, converting decimal to %

example:

W_i = 522.0 g
W_a = 521.8

$$D = \frac{522.0 - 521.8}{522.0} \times 100$$

$$= \frac{0.2}{522.0} \times 100$$

$$= 0.000383 \times 100$$

$$= 0.0383$$

$$D = 0.04\ \%$$

B. Calculate the percent retained for each sieve using the following formula:

$$R = \frac{W_x}{W_a} \times 100$$

where:

R = percent retained
W_x = mass retained on each individual sieve (x),g
W_a = accumulated total, g
100 = constant, converting decimal to %.

example: *4.75 mm sieve*

$W_{4.75}$ = 20.4 g
W_a = 521.8 g

$$R = \frac{20.4}{521.8} \times 100$$

$$0.039095 \times 100$$

$$= 3.9095$$

$$R = 3.91$$

C. Calculate the Percent Coarser (Cumulative Percent Retained) for each sieve using the following formula:

$$C_x = \sum R_x$$

where x goes from all sieves >x to x

where:

C_x = percent coarser for each sieve (x)
R_x = percent retained for sieve (x)
$\sum$ = sum of percent retained on all sieves larger than sieve (X)

example:

$R_{9.5} = 0$
$R_{4.75} = 3.91$
$R_{1.18} = 12.90$

$C_{1.18mm} = 0 + 3.91 + 12.90$

$C_{1.18mm} = 16.81$

D. Calculate the Percent Passing for each sieve using the following formula:

$$P_x = 100 - C_x$$

where:

P = percent passing
C_x = percent coarser for sieve x
100 = constant representing 100%

example: *for 1.18mm Sieve*

$C_{1.18} = 16.81$

$$P_{1.18} = 100 - 16.81$$

$$= 83.19$$

$P_{1.18\ mm} = 83\ \%$

VI. Report

Report the results of the sieve analysis to the nearest whole percent.

VII. Normal Testing and Reporting Time

Normal testing and reporting time is 2 days.

MATT MENU SELECTION - 2

Louisiana Department of Transportation and Development
AGGREGATE TEST REPORT

DOTD 03-22-0745
Metric / English
Rev. 11/98

Metric / English: M (M or E - Located on MATT Menu)
Project No.: 999-99-9999 | Material Code: 570 | Lab No.: 22-999999
Date Sampled: 04-23-99 | Submitted By: 0071 | Quantity: 1000
Purp Code: 3 | Source Code: AA99 | Spec Code: 4 | P.O. No.:
Date Tested: 04-24-99 | Ident: SAND | Plant Code: | Frict.Rating: (1-4)
Item No.: A01 (01) | Date Rec'd (lab): 4/23/99 | Sampled By: G.C.
Remarks 1:
Tested By: N.H. | Date: 4/24/99 | Checked By: B.W. | Date: 4/24/99

DOTD TR 102, 112, 113 & 309

Unit: 1 (1 = grams 2 = pounds)

Sieve mm	Sieve In.	Mass (Wt) Retained	% Retained	% Coarser	% Passing
63	2 1/2				
50	2				
37.5	1 1/2				
31.5	1 1/4				
25.0	1				
19.0	3/4				
16.0	5/8				
12.5	1/2				
9.5	3/8	0	0	0	100
4.75	No. 4	20.4	3.91	3.91	96
Mass (Wt) Met.In Pan					
Accum. Total					

Initial Dry Total Mass, (Wt): | % Diff:

Unit: 1 (1 = grams 2 = pounds)

Sieve mm/µm	Sieve No.	Mass (Wt) Retained	% Retained	% Coarser	% Passing
2.36	8				
2.00	10				
1.18	16	67.3	12.90	16.81	83
600	30	102.8	19.70	36.51	
425	40	131.2	25.14	61.65	
300	50	118.4	22.68	84.34	16
180	80				
150	100	65.5	12.55	96.89	3
75	200	13.0	2.49	99.38	1
53	270				
Mass (Wt) Met.In Pan		0.9	0.61	99.99	
Decant Loss		2.3	99.99		
Accum. Total		521.8			
Initial Dry Total Mass, (Wt)		519.7	% Diff:	0.04	
Dry Mass (Wt) After Wash		519.7			

Remarks 2:

DOTD TR 428

Liquid Limit: | Plastic Limit:
No. of Blows: | Mass Cup + Wet Soil,g: | Mass Cup + Dry Soil,g: | Mass Water: | Cup No.: | Mass Cup, g: | Mass Dry Soil: | % Moisture:
Factor:
Plasticity Index:

Absorption, % (T84 or T85)	
Spec Grav SSD (T84 or T85)	
Spec Grav APP (TR 300)	
Effective Spec Grav (TR 300)	
Opt Moist Content, % (TR 418)	
Maximum Density (TR 418) kg/m³ (lb/ft³)	
Lab Comp Method (TR 418)	
Cement, % (TR 432 or SPECIFIED)	
Lime, % (TR 416 or SPECIFIED)	
Other (Additive) Code %	
Clay Lumps, % (TR 119)	
Friable Particles, % (TR 119)	
Clay Lumps & Friable Particles % (TR 119)	
Flat or Elongated Part, % (TR 119)	
Coal & Lignite, % (TR 119)	
Glassy Particles, % (TR 119)	
Iron Ore, % (TR 119)	
Wood, % (TR 119)	
Total (Clay Lumps, Fri.Part., Iron Ore, Coal & Lignite, Wood), % (TR 119)	
Foreign Matter, % (TR 109)	
Clam Shell, % (TR 110)	
Soundness, % Loss (T 104)	
Abrasion, % Loss (T 96)	
Colorimetric Test (1 = Pass, 2 = Fail) (T 21)	
Asphalt Content, % (TR 307)	
Retained Asphalt Coating, % (TR 317)	
Percent Crushed (TR 306)	
Retained Marshall Stability (TR 313)	
Resistivity, ohm - cm (TR 429)	
pH (TR 430)	
Organic Content, % (TR 413)	
Sand Equivalent (TR 120)	

Approved By: _____ Date: _____

Figure B-1 Aggregate Test Report (03-22-0745)

DOTD Designation: TR 113M/113-99

Method C

I. Scope

This method of test is used in conjunction with DOTD TR 112 to determine the particle size distribution of aggregates by dry sieving the material retained on the 4.75 mm (No. 4) sieve, then washing and dry sieving the material passing the 4.75 mm (No. 4) sieve (split sample).

II. Apparatus

A. **Balance**
   1. Sample size 2 kg or less, readability and sensitivity to 0.1 g
   2. Sample size greater than 2 kg, but not more than 5 kg, readability and sensitivity to 1 g
   3. Sample size greater than 5 kg, readability and sensitivity to 5 kg

B. **Mechanical Sieve Shaker** - capable of imparting a vertical or lateral and vertical motion to the sieves, causing the particles thereon to bounce and turn, presenting different orientations to the sieving surface

C. **Sieves** - conforming to the requirements of AASHTO M92. Sieve sizes will be appropriate for the specifications for which the material is being tested. Additional sieves may be necessary to prevent overloading of these primary sieves.

D. **Catch Pan**

E. **Drying Device**
   1. Oven - an oven capable for maintaining a temperature of 110 ±5°C (230 ±9°F).
   2. Hot Plate - an approved hot plate with a shield. Open-flame hot plates must be equipped with a shield which evenly disperses heat and prevents direct contact of the flame with the drying pan.

F. **Miscellaneous Tools** - spoons, spatulas, brushes, etc.

G. **Personal Protective Equipment** - goggles, dust respirator, equipment for handling hot substances

H. **Aggregate Test Report** - DOTD Form No. 03-22-0745 (Figure C-1)

III. Health Precautions

Proper equipment and precautions are to be used whenever hot materials or equipment must be handled. Use container holders or gloves while handling hot containers. Use appropriate respirator and turn on ventilation system when working in dusty areas.

IV. Sample

Sample adequate material to comply with Table 1 after drying to constant mass; however, in no case, shall the minimum sample size be less than 13 kg.

V. Procedure

A. Dry the sample in accordance with TR 106.

B. Obtain a representative portion, in accordance with TR 108, which will yield at least the minimum quantity shown in Table 1. Record on the worksheet as initial dry total mass in the upper entry field.

Table 1

Approximate Minimum Mass of Dry Representative Portion

Representative Portion	
[1]Maximum Size	Approximate Minimum Mass, Dried
90 mm (3 ½ in)	35 kg
75 mm (3 in)	30 kg
63 mm (2 ½ in)	25 kg
50 mm (2 in)	20 kg
37.5 mm (1 ½ in)	13 kg
25.0 mm (1 in)	10 kg
19.0 mm (3/4 in)	5 kg
12.5 mm (½ in)	2 kg
9.5 mm (3/8 in)	1 kg
4.75 mm (No. 4)	500 g
2.36 mm (No. 8)	100 g

[1]**Maximum Size** - for the purpose of this test procedure, maximum size is defined as the first sieve on which the specifications allow material to be retained.

C. Use the specifications to select the appropriate sieves, from the largest to the 4.75 mm (No. 4) sieve, to determine the particle distribution of the coarse fraction and the amount of material passing the 4.75 mm (No. 4) sieve in accordance with Steps V. D - J of Method A.

D. Determine the particle distribution of the material passing the 4.75 mm (No. 4) sieve in accordance with Steps V. B - K. of Method B.

VI. Calculations

A. Calculate the percent difference for the total material using the following formula:

$$D = \frac{W_i - W_a}{W_i} \times 100$$

where:

D = percent difference
W_i = initial dry total mass of rep. portion prior to split, g
W_a = accumulated total mass of rep. portion prior to split, g
100 = constant, converting decimal to %

example:

W_i = 15 784
W_a = 15 782

$$D = \frac{15\ 784 - 15\ 782}{15\ 784} \times 100$$

$$= \frac{2}{15\ 784} \times 100$$

$$= 0.000126 \times 100$$

$$= 0.0126$$

$$D = 0.01\%$$

B. Calculate the percent retained in the pan and for the 4.75 mm (No. 4) and coarser sieves using the following formula:

$$R_x = \frac{W_x}{W_a} \times 100$$

where:

R = percent retained
W_x = mass retained on each individual sieve or pan (x), g
W_a = accumulated total, g
100 = constant, converting decimal to %

example: *4.75 mm (No. 4) sieve*

$W_{4.75}$ = 7 841
W_a = 15 782

$$R_{4.75} = \frac{7\ 841}{15\ 782} \times 100$$

$$= 0.496831 \times 100$$

$$= 49.6831$$

$$R_{4.75} = 49.68$$

C. Calculate the Percent Coarser (Cumulative Percent Retained) for the 4.75 mm (No. 4) and coarser sieves using the following formula:

$$C_x = \sum R_x$$

where x goes from all sieves >x to x

where:

C_x = percent coarser for each sieve (x)
R_x = percent retained for sieve (x)
$\sum$ = sum of percent retained on all sieves larger than sieve (X)

example:

$R_{37.5}$ = 0.98 mm
$R_{4.75}$ = 49.68 mm

$$C_{4.75mm} = 0.98 + 49.68$$

$$C_{4.75mm} = 50.66$$

D. Calculate the Percent Passing for the 4.75 mm (No. 4) and coarser sieves using the following formula:

$$P_x = 100 - C_x$$

where:

P_x = percent passing
C_x = percent coarser for sieve x
100 = constant representing 100%

example: *4.75 mm (No. 4) Sieve*

$C_{4.75}$ = 50.66 mm

$$P_x = 100 - 50.66$$

$$P_x = 49.34$$

$$P_x = 49$$

E. Calculate the percent difference for the material passing the 4.75 mm (No. 4) sieve, using the following formula:

$$d = \frac{w_i - w_a}{w_i} \times 100$$

where:

d = percent difference
w_i = initial dry total Mass of the Split portion passing the 4.75 mm (No. 4) sieve, g
w_a = accumulated total mass of the split portion passing the 4.75 mm (No. 4) sieve, g
100 = constant, converting decimal to %

example:

w_i = 538.4 g
w_a = 538.1 g

$$d = \frac{538.4 - 538.1}{538.4} \times 100$$

$$= \frac{0.3}{538.4} \times 100$$

$$= 0.000557 \times 100$$

$$= 0.0557$$

$$d = 0.06\%$$

F. Calculate the percent retained for each sieve smaller than the 4.75 mm (No. 4) sieve using the following formula:

$$r_x = \frac{w_x}{w_a} \times R_{pan}$$

where:

r_x = percent retained on each sieve
w_x = mass retained on each individual sieve (x), g
w_a = accumulated total, g
R_{pan} = percent of total material retained in the pan, calculated in Step B

example: *425 mm sieve*

w_{425mm} = 189.2 g
w_a = 538.1 g
R_{pan} = 49.32

$$r_{425mm} = \frac{189.2}{538.1} \times 49.32$$

$$= 0.035160 \times 49.32$$

$$= 17.3409 = 17.34$$

$$r_{425mm} = 17.34$$

G. Calculate the Percent Coarser (Cumulative Percent Retained) for each sieve smaller than the 4.75 mm (No. 4) sieve using the following formula:

$$c_x = \sum r_x + \sum R_x$$

where x goes from all sieves >x to x

where:

c_x = percent coarser for each sieve (x)
r_x = percent retained for sieve (x)
$\sum$ = sum of percent retained on all sieves larger than sieve (X)
$\sum R_x$ = sum of percent retained on 4.75 mm (No. 4) and coarser sieves

example:

$R_{75\mu m}$ = 16.38
$R_{4.25\mu m}$ = 17.34
$\sum R_{4.75mm}$ = 50.66

$$c_{75\mu m} = 16.38 + 17.34 + 50.66$$

$$C_{75\mu m} = 84.38$$

H. Calculate the Percent Passing for each sieve finer than the 4.75 mm (No. 4) using the following formula:

$$p_x = 100 - c_x$$

where:

p_x = material passing sieve x, %
c_x = material coarser than sieve x, %
100 = constant representing 100%

example: *75 µm (No. 200) sieve*

$C_{75\mu m}$ = 84.38

$$p_{75\mu m} = 100 - 84.38$$

$$= 15.62$$

$$p_{75\mu m} = 16\ \%$$

VII. Report

Report the results of the sieve analysis to the nearest whole percent.

VIII. Normal Testing and Reporting Time

Normal testing and reporting time is 2 days.

MATT MENU SELECTION - 2

Louisiana Department of Transportation and Development

AGGREGATE TEST REPORT

DOTD 03-22-0745
Metric / English
Rev. 11/98

Metric / English: M (M or E - Located on MATT Menu)

Project No.: 999-99-9999 | Material Code: 5710 | Lab No.: 22-999999
Date Sampled: 05-10-99 | Submitted By: 0071 | Quantity: 1000
Purp Code: 3 | Source Code: AA99 | Spec Code: 1 | P.O. No.:
Date Tested: 05-11-99 | Ident: | Plant Code: | Frict.Rating: (1-4)
Item No.: 601(01) | Date Rec'd (lab): 5-10-99 | Sampled By: C.G.
Remarks 1:

Tested By: N.H. | Date: 5/11/99 | Checked By: B.W. | Date: 5/11/99

DOTD TR 102, 112, 113 & 309

Unit: 1 = grams 2 = pounds

Sieve mm	Sieve In.	Mass (Wt) Retained	% Retained	% Coarser	% Passing
63	2 1/2				
50	2				
37.5	1 1/2	156	0.98	0.98	99
31.5	1 1/4				
25.0	1				
19.0	3/4				
16.0	5/8				
12.5	1/2				
9.5	3/8				
4.75	No. 4	7841	49.68	50.66	49
Mass (Wt) Met.in Pan		7785	49.32		
Accum. Total		15782			
Initial Dry Total Mass, (Wt)		15784	% Diff:	0.01	

Unit: 1 = grams 2 = pounds

Sieve mm/µm	Sieve No.	Mass (Wt) Retained	% Retained	% Coarser	% Passing
2.36	8				
2.00	10				
1.18	16				
600	30				
425	40	189.2	17.34	68.00	32
300	50				
180	80				
150	100				
75	200	178.8	16.38	84.38	16
53	270				
Mass (Wt) Met.in Pan		30.7	2.81		
Decant Loss		139.4			
Accum. Total		538.7			
Initial Dry Total Mass, (Wt)			% Diff:	0.04	
Dry Mass (Wt) After Wash					

Remarks 2:

DOTD TR 428

Liquid Limit: | Plastic Limit:

No. of Blows		Mass Cup + Wet Soil,g	
Mass Cup + Wet Soil,g		Mass Cup + Dry Soil,g	
Mass Cup + Dry Soil,g		Mass Water	
Mass Water		Cup No.	
Factor		Mass Cup, g	
Cup No.		Mass Dry Soil	
Mass Cup, g		% Moisture	
Mass Dry Soil			
% Moisture			

Plasticity Index:

Absorption, % (T84 or T85)	
Spec Grav SSD (T84 or T85)	
Spec Grav APP (TR 300)	
Effective Spec Grav (TR 300)	
Opt Moist Content, % (TR 418)	
Maximum Density (TR 418) kg/m³ (lb/ft³)	
Lab Comp Method (TR 418)	
Cement, % (TR 432 or SPECIFIED)	
Lime, % (TR 416 or SPECIFIED)	
Other (Additive) Code %	
Clay Lumps, % (TR 119)	
Friable Particles, % (TR 119)	
Clay Lumps & Friable Particles % (TR 119)	
Flat or Elongated Part, % (TR 119)	
Coal & Lignite, % (TR 119)	
Glassy Particles, % (TR 119)	
Iron Ore, % (TR 119)	
Wood, % (TR 119)	
Total (Clay Lumps, Fri.Part., Iron Ore, Coal & Lignite, Wood), % (TR 119)	
Foreign Matter, % (TR 109)	
Clam Shell, % (TR 110)	
Soundness, % Loss (T 104)	
Abrasion, % Loss (T 96)	
Colorimetric Test (1 = Pass, 2 = Fail) (T 21)	
Asphalt Content, % (TR 307)	
Retained Asphalt Coating, % (TR 317)	
Percent Crushed (TR 306)	
Retained Marshall Stability (TR 313)	
Resistivity, ohm - cm (TR 429)	
pH (TR 430)	
Organic Content, % (TR 413)	
Sand Equivalent (TR 120)	

Approved By: _____ Date: _____

Figure C-1 Aggregate Test Report (03-22-0745)